

Swift Observations of GRB 100302A

J. R. Cummings (CREST/GSFC), Valerio D'Elia (ASDC), H. A. Krimm (CREST/GSFC), M. Perri (ASDC), M. A. Stark (PSU), S. D. Barthelmy (GSFC), D. N. Burrows (PSU), P. Roming (PSU), N. Gehrels (GSFC), for the Swift Team

1. INTRODUCTION

At 19:53:06 UT, the Swift Burst Alert Telescope (BAT) triggered and located GRB 100302A (trigger=414592). Swift slewed immediately to the burst. The most-accurate location determined by Swift is the XRT enhanced position RA, Dec 195.51524, +74.58959 which is equivalent to:

RA (J2000): 13h 02m 3.66s
Dec (J2000): +74d 35' 22.5"

with an uncertainty of 1.9 arcsec (radius, 90% confidence).

The XRT began observing the field at 19:55:11.9 UT, 125.4 seconds after the BAT trigger. UVOT took a finding chart exposure of 150 seconds with the White filter starting 132 seconds after the BAT trigger. No credible afterglow candidate was found.

Ground-based telescopes (*prima* Lulin) found an optical afterglow (Huang *et al.*, GCN Circ 10461). The redshift was determined (using Gemini-North, Chornock *et al.*, GCN Circ 10466) to be 4.813.

2) BAT OBSERVATION AND ANALYSIS

Using the data set from T-60 to T+243 sec, the BAT ground-calculated position is RA, Dec = 195.504, 74.568 deg which is

RA(J2000): 13h 02m 01.0s
Dec(J2000): +74d 34' 04"

with an uncertainty of 1.7 arcmin, (radius, sys+stat, 90% containment). The partial coding was 98%.

The mask-weighted light curve shows one group of multiple overlapping peaks from T+40 to T+70. See Figure 1. T₉₀ (15-350 keV) was 17.9 ± 1.7 sec (estimated error including systematics).

The time-averaged spectrum from T+47.6 to T+67.3 sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 1.72 ± 0.19 . The fluence in the 15-150 keV band was $3.1 \pm 0.4 \times 10^{-7}$ erg/cm². The 1-sec peak photon flux measured from T+63.87 sec in the 15-150 keV band was 0.5 ± 0.1 ph/cm²/sec. All the quoted errors are at the 90% confidence level.

The results of the batgrbproduct analysis are available at http://gcn.gsfc.nasa.gov/notices_s/414592/BA/

3. XRT OBSERVATION AND ANALYSIS

We have analysed Swift-XRT data obtained from GRB 100302A from 125 s to 10⁶ s after the BAT trigger. The 0.3-10 keV light curve shows a multiple peak structure, with three main spikes at about T+200, T+250 and T+400s, followed by a fast decay with index 3.35 ± 0.3 and by a break at 1ks. Later time data are fitted by a second power law with a decay index of 0.44 ± 0.07 , a break at 28 (+9, -11) ks followed by a decay index of 0.90 ± 0.07 . See Figure 2.

A spectrum formed from the PC mode data from 125 s to 28.8 ks after the BAT trigger can be fitted with an absorbed power-law with a photon spectral index of $2.28 (-0.15, +0.17)$. The best-fitting absorption column is $1.1 (-0.20, +0.17) \times 10^{21}$ cm⁻², in excess of the Galactic value of 1.9×10^{20} cm⁻² (Kalberla *et al.* 2005).

The counts to observed (unabsorbed) 0.3-10 keV flux conversion factor deduced from this spectrum is 3.3×10^{-11} (4.7×10^{-11}) erg cm⁻² count⁻¹.

The results of the XRT-team automatic analysis are available at http://www.swift.ac.uk/xrt_products/00414592.

4. UVOT OBSERVATION AND ANALYSIS

The Swift/UVOT began settled observations of the field of GRB 100302A 132 s after the BAT trigger. No optical afterglow consistent with the XRT position was detected in the initial nor later UVOT exposures. We did not see any source within the XRT error circle that might correspond to the R and I-band source reported by Huang *et al.* (GCN 10461) from the Lulin 1-meter telescope or the i' source reported by Cucchiara and Fox (GCN 10465) from Gemini-N.

Preliminary $3\text{-}\sigma$ upper limits using the UVOT photometric system (Poole *et al.* 2008, MNRAS, 383, 627) for the initial exposures are given in Table 1. The values quoted in the table are not corrected for the Galactic extinction due to the reddening of $E_{(B-V)} = 0.02$ in the direction of the burst (Schlegel *et al.* 1998).

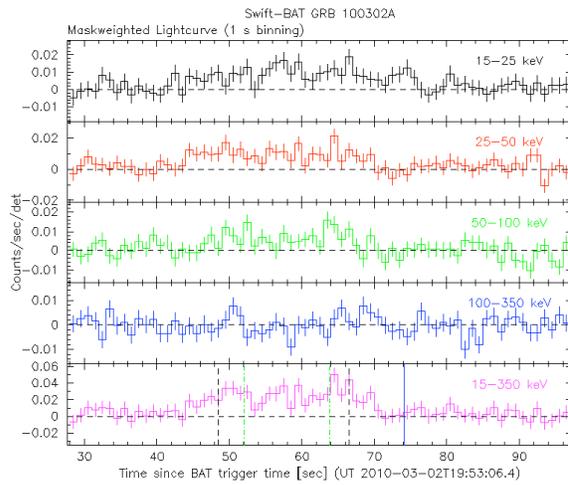


Fig.1: BAT Lightcurve. The non-maskweighted lightcurve in the 4 individual plus total energy bands.

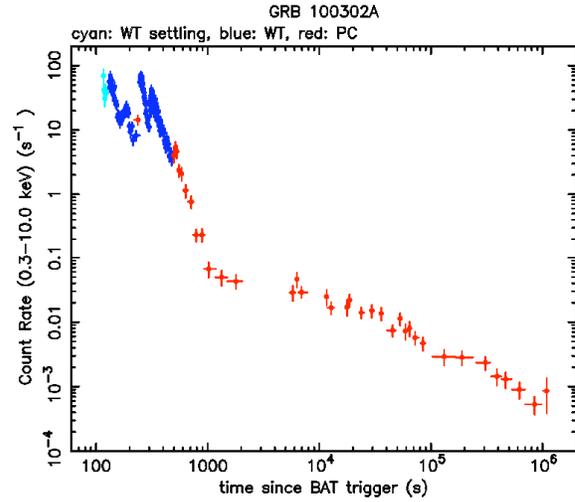


Figure 2: XRT Lightcurve.

Table 1

Filter	T_start(sec)	T_stop(s)	Exp(s)	Mag UL (3σ)
white_FC	133	282	147	>21.06
white	133	2044	431	>21.24
v	621	1933	156	>18.82
b	547	2032	136	>19.58
u	291	2007	382	>20.10
w1	670	1982	155	>19.49
m2	645	1957	136	>19.26
w2	596	1908	156	>19.61